Pushing the Limits of Hard X-Ray Coherent Diffraction Imaging in Terms of Resolution and Sensitivity

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Scanning coherent diffraction microscopy, also known as ptychography, has great potential to close the mesoscopic gap and reach into the range of length scales between 10 nm and the atomic scale. While in conventional scanning microscopy the spatial resolution is limited by the lateral size of the nanobeam and thus by the numerical aperture of the nanofocusing optic, the spatial resolution and contrast in a ptychogram depend on the coherent fluence on the sample [1]. In addition, whether a given feature in the object can be resolved or not depends on its shape (structure factor) and can vary for different features in the object [1].

Based on these considerations, the route to highest spatial resolution and sensitivity is discussed, extrapolating from current experiments. The optimal ptychographic x-ray microscope needs a source with highest possible brilliance and x-ray optics with large numerical aperture to generate the optimal probe beam. Thus, the optimal ptychographic microscope is at the same time the best conventional scanning microscope. In addition, in order to resolve weak features within an object and exploit resonant scattering to obtain chemical sensitivity [2], the background scattering needs to be minimized, requiring special data acquisition strategies.

References

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